ENTECH
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PRELIMINARY SUBSURFACE SOIL INVESTIGATION
THE ESTATES AT ROLLING HILLS RANCH, FILING 1 AND 2
EL PASO COUNTY, COLORADO

Prepared for:

Tech Contractors
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Attn: Mr. Raul Guzman

September 10, 2019

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Daniel P. Stegman

Reviewed by:

Joseph C. Goode, Jr., P.E.
President

DPS/ts

Encl.

Entech Job No. 191234
AAprojects/2019/191234/191234 SSI

PUDSP 19-007
SF 19-019
PUD-SP-204
SF-20-018

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PRELIMINARY SUBSURFACE SOIL INVESTIGATION
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1.0 INTRODUCTION

The project consists of the development of the site for the construction of single-family residences in The Estates at Rolling Hills Ranch, Filing 1 and 2. Development is expected to include site grading, installation of subsurface utilities, roadways, and drainage structures. The subdivision is in Meridian Ranch in the northern portion of El Paso County, Colorado. The approximate location of the project site is shown on the Vicinity Map, Figure 1. The test boring locations are shown on Figure 2, the Test Boring Location Plan, with the approximate delineation of soil types and potential depths to bedrock depicted on the plan.

This report describes the subsurface investigation conducted for the site and provides recommendations for development design and construction. The Subsurface Soil Investigation included the drilling of twelve test borings across the site, collecting samples of soil, and conducting a geotechnical evaluation of the investigation findings. All drilling and subsurface investigation activities were performed by Entech Engineering, Inc. (Entech). The contents of this report, including the geotechnical evaluation and recommendations, are subject to the limitations and assumptions presented in Section 17.0.

2.0 PROJECT AND SITE DESCRIPTION

The project will consist of developing the site for single family residential structures. The planned lots are located in The Estates at Rolling Hills Ranch, Filing 1 and 2 subdivision in Meridian Ranch. The investigation was performed at predetermined locations designated based on the roadway alignment and proposed grading on the site plan provided to us. At the time of drilling, the site was vacant and not developed. The site is not graded for the planned development. Site grading plans were not provided. The site has a gradual slope towards the southeast. Vegetation consisted of grasses and weeds. Undeveloped land, existing residences, and Falcon High School are located to the west and south of the site, undeveloped land immediately north and east, with Eastonville Road approximately 1-mile to the east. Small drainages traverse across the property trending to the southeast. A larger natural earthen drainage trends to the southeast commencing at the southeast corner of the property near Rex Road. Small fill piles exist on portions of the property, likely from nearby developments.

3.0 SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

Subsurface conditions on the site were explored by drilling twelve test borings at the approximate locations shown on Figure 2. The boring locations were determined and staked by others. The borings were drilled within the proposed roadway alignments. The borings were drilled to depths of 20 feet below the existing ground surface (bgs). The drilling was performed using a truck-mounted, continuous flight auger-drilling rig supplied and operated by Entech. Boring logs descriptive of the subsurface conditions encountered during drilling are presented in Appendix A. At the conclusion and subsequent to drilling, observations for groundwater levels were made in each of the open boreholes.

Soil and bedrock samples were obtained from the borings utilizing the Standard Penetration Test (ASTM D-1586) using 2-inch O.D. split-barrel and California samplers. Results of the Standard Penetration Test (SPT) are included on the boring logs in terms of N-values expressed in blows per foot (bpf). Soil and bedrock samples recovered from the borings were visually classified and recorded on the boring logs. The soil and bedrock classifications were later verified utilizing laboratory testing and grouped by soil type. The soil and bedrock type numbers are included on the boring logs. It should be understood that the soil and bedrock descriptions shown on the boring logs may vary between boring location and sample depth. It

should also be noted that the lines of stratigraphic separation shown on the boring logs represent approximate boundaries between soil and bedrock types and the actual stratigraphic transitions may be more gradual or variable with location.

Water content testing (ASTM D-2216) was performed on the samples recovered from the borings, and the results are shown on the boring logs. Grain-Size Analysis (ASTM D-422) and Atterberg Limits testing (ASTM D-4318) were performed on selected samples to assist in classifying the materials encountered in the borings. Volume change testing was performed on selected samples using the Swell/Consolidation Test (ASTM D-4546) and the FHA Swell Test in order to evaluate potential expansion/compression characteristics of the soil and bedrock. Soluble sulfate testing was performed on select soil samples to evaluate the potential for below grade degradation of concrete due to sulfate attack. The Laboratory Testing Results are summarized on Table 1 and are presented in Appendix B.

4.0 SUBSURFACE CONDITIONS

One soil type and two bedrock types were encountered in the test borings drilled for the subsurface investigation: Type 1: native slightly silty to silty sand and clayey sand (SM-SW, SM, SC), Type 2: weathered to formational slightly silty to silty sandstone and clayey to very clayey sandstone (SM-SW, SM, SC), and Type 3: very sandy claystone (CL). The soil and bedrock were classified in accordance with the Unified Soil Classification System (USCS) and American Association of State Highway and Transportation Officials (AASHTO) System using the laboratory testing results and the observations made during drilling.

4.1 Soil and Bedrock

Soil Type 1 classified as native slightly silty to silty sand and clayey sand (SM-SW, SM, SC). The sand was encountered in all of the test borings at the existing ground surface and extending to depth ranging from 1 to 9 feet below ground surface (bgs). Standard Penetration Testing conducted on the sand resulted in SPT N-values ranging from 15 to 42 blows per foot (bpf), indicating medium dense to dense states. Water content and grain size testing of selected soil samples resulted in a water content range of 2 to 12 percent, and 8 to 22 percent of the soil particles passing the No. 200 sieve. Atterberg limits testing resulted in Liquid Limits of 33 and no value and Plastic Indexes 16 and non-plastic, respectively. FHA Swell testing

resulted in swell pressure between 30 and 130 psf, indicating low expansion potentials. Sulfate testing resulted in less than 0.01 percent soluble sulfate by weight, which indicates a negligible potential for below grade concrete degradation due to sulfate attack.

Soil Type 2 classified as weathered to formational slightly silty to silty sandstone and clayey to very clayey sandstone (SM-SW, SM, SC). The sandstone was encountered in all test borings, underlying Soil Types 1 and 3 at depths ranging from 1 to 14 feet bgs and extending to depths ranging from 13 to 19 feet bgs and to the termination of the borings (20 feet). Standard Penetration Testing conducted on the sandstone resulted in SPT N-values from 38 to greater than 50 bpf, which indicates dense to very dense states. Water content and grain size testing resulted in a water content range of 2 to 13, and 8 to 48 percent of the soil particles passing the No. 200 sieve. Atterberg limits testing resulted in Liquid Limits of 29 and no value and Plastic Indexes 12 and non-plastic, respectively. Swell/Consolidation testing on the sandstone resulted in a volume change of 0.5 percent, indicating a low expansion potential. Sulfate testing on the sandstone resulted in less than 0.01 percent sulfate by weight indicating the sandstone exhibits a negligible potential for below grade concrete degradation due to sulfate attack.

Soil Type 3 classified as very sandy claystone (CL). The claystone was encountered in Test Boring Nos. 1, 11, and 12 underlying Soil Types 1 and 2 at depths ranging from 4 to 14 feet bgs and extending to depths ranging from 14 to 16 feet bgs and to the termination of the borings (20 feet). Standard Penetration Testing conducted on the claystone resulted in SPT N-values of greater than 50 bpf, which indicates hard consistencies. Water content and grain size testing resulted in a water content range of 8 to 15, and 58 percent the soil size particles passing the No. 200 sieve. Swell/Consolidation testing on the claystone resulted in a volume change of 3.1 percent, indicating a moderate to high expansion potential.

4.2 Groundwater

Depth to groundwater was measured in each of the borings at the conclusion of drilling and subsequent to drilling. Groundwater was encountered in five of the twelve test borings, ranging from depths of 12 to 17 feet bgs. Groundwater may affect building foundation excavations, roadway and utilities construction on this site, depending on the final grading plans. It should be noted that groundwater levels could change due to seasonal variations, changes in land runoff

characteristics and future development including nearby areas. Table 2 presents the estimated depths to bedrock and groundwater.

5.0 PRELIMINIARY DEVELOPMENT CONSIDERATIONS

The following discussion is based on the subsurface conditions encountered in the test borings drilled at the site. This investigation is for the site discussed in 2.0 Project and Site Description. If subsurface conditions different from those described herein are encountered during construction or if the project elements change from those described, Entech Engineering, Inc. should be notified so that the evaluation and recommendations presented can be reviewed and revised if necessary.

Subsurface soil conditions encountered in the test borings drilled on the site generally consisted of native slightly silty to silty sand, and clayey sand overlying weathered to formational slightly silty to silty sandstone and clayey to very clayey sandstone, and very sandy claystone. Bedrock was encountered at depths ranging from 1 to 9 feet bgs. Depths to bedrock are indicated on the test boring plan and in Table 2. Consideration should be given to several conditions on this site in planning and excavating the development including groundwater, expansive soils and sandstone/claystone materials.

5.1 Groundwater

Groundwater may impact the development. Table 2 presents the depth to groundwater measured in each boring. Subsequent to completion of overlot grading where areas of cuts are anticipated, the measured water levels may be less than 10 feet in some areas of the site. Unstable conditions should be expected where groundwater is shallow or close to excavated depths. Procedures and equipment to mitigate groundwater impact during and after construction should be anticipated. Pumps, cofferdams, wide area and localized drain systems and other procedures and equipment may be necessary. Shotrock and geotextiles may be appropriate for stabilizing excavations. An underdrain system can be considered for long term groundwater mitigation. Frequently, groundwater levels rise following development as result of increased irrigation and decreased potential area of evaporation.

5.2 Expansive Soils

Expansive soils consisting of claystone, and clay (not encountered in the test borings) are present on the site exhibiting expansion potentials. Expansive soils where encountered will require mitigation for residential construction. Damage to structures can occur due to expansive soils; occurrence and severity of distress can be reduced by moisture treatments and overexcavation mitigation approaches.

5.3 Sandstone and Claystone

Sandstone and claystone were encountered at shallow depths across the site. Excavation of sandstone and claystone should be expected to be moderate to difficult. Track type equipment likely will be needed to accomplish excavations particularly where harder materials or lenses are present. Upon completion of site grading per the plan provided to us, sandstone is expected to be exposed across the majority of the areas tested.

6.0 SITE GRADING

Shallow bedrock was encountered in a majority of the test borings. Depth to bedrock in each boring is indicated on the Test Boring Plan, Figure 2. Excavation of dense and hard materials on site is expected to be moderate to difficult with heavy duty earthmoving equipment. Claystone and sandstone materials may require track equipment and ripping teeth. Bedrock materials will likely require processing prior to placement in fill areas. For conditions with no groundwater seepage, cut and fill slopes no steeper than 3 to 1 (horizontal to vertical) should be considered. If seepage occurs, then flatter slopes or a drain system should be considered. Recommendations may be subject to change depending upon particular field conditions.

6.1 Stripping

Debris, topsoil and organic materials should be stripped from the ground surface of areas to be filled. Any uncontrolled fill materials should be completely removed. The materials may be used as fill pending approval if they are free of organic material and debris. Although soft areas are not expected any soft or loose soils should be stabilized or removed to expose suitable material prior to placement of fill. Topsoil may be stored in stock piles and placed at the surface in landscape areas.

6.2 Fill Preparation

Surfaces which will receive fill should be scarified to depths of 6 inches, moisture conditioned to within 0 to 3 percent of optimum moisture, and compacted to minimum of 95 percent of Standard Proctor Dry Density (ASTM D-698) for cohesive materials and within 2 percent of optimum moisture, and compacted to minimum of 95 percent of Modified Proctor Dry Density (ASTM D-1557) for cohesionless soils. On-site natural soils and bedrock are anticipated to be used as site grading fill. Bedrock must be processed and broken down to small gravel-sized materials where placed in the fill. Expansive materials used for fill should be placed at sufficient moisture content to mitigate potential swell. The fill quality will influence the performance of foundations, slabs-on-grade, and pavements. Fill settlement can be minimized by placing thin lifts at suitable moisture content and by verification of compaction with frequent density tests.

6.3 Compaction

Overlot grading fill consisting of granular soils should be placed in lifts to exceed 6 inches following compaction and compacted to at least 95 percent of the maximum dry density determined by Modified Proctor (ASTM D-1557). Clay materials should be placed in compacted lifts less than 6 inches thick compacted to at least 95 percent of maximum Standard Proctor (ASTM D 698) dry density. Fills below 10 feet in depth should be moisture conditioned as above and compacted to 98 percent of Standard Proctor dry density (ASTM D 698) for cohesive materials or 98 percent of maximum modified Proctor Dry Density (ASTM D 1557) for granular materials. The soil materials should be placed at a moisture content conducive to adequate compaction, usually within ±2 percent of optimum moisture content. Fill placement and compaction should be observed and tested by Entech during construction to verify that adequate moisture and density has been achieved.

7.0 UNDERGROUND UTILITY CONSTRUCTION

Generally excavation is expected to be moderate to difficult utilizing heavy-duty track hoes. Rock buckets and rock teeth will likely be required where excavations extend into very dense sandstone, hard claystone, or cemented materials. Special procedures or equipment may be required to remove water and/or achieve stability in utility trenches where excavations approach or intercept groundwater.

Utilities including water and sewer lines are usually constructed beneath paved roads. Placement of fill and degree of compaction applied to trench backfill will influence performance of overlying structures including pavements. Fill placed into utility trenches should be compacted according to requirements of the local jurisdiction. Fill should be placed in horizontal lifts having compacted thickness of six inches or less and at a water content conducive adequate compaction, usually within ±2 percent of optimum water content. Typical compaction specifications would be similar to specifications in the Site Grading section. Mechanical methods should be used for fill placement; however, heavy equipment should be kept at a distance away from structures to avoid damage. No water flooding techniques of any type should be used for compaction or placement of utility trench backfill.

Trench backfill should be performed in accordance with El Paso County specifications and requirements. Excavations and excavation shoring/bracing should be performed in accordance with OSHA guidelines.

8.0 UNDERDRAIN SYSTEM

Depending on final site grading anticipated depths of excavations and structure foundations relative to groundwater occurrence, an underdrain system may be considered to be included as part of sewer system design and installation. The underdrain system drain pipe shall consist of smooth wall non perforated rigid PVC pipe placed at a minimum slope of 2 percent. Shallower pipe grades can be considered for larger diameter underdrain pipes and areas to daylight the drainage systems. Concrete or clay material fill may be strategically placed at the manhole locations to slow the water flow down the trench. The underdrain below sewer should be constructed with adequate depth to allow connection of residence foundation drain systems. Drain elements should be of appropriate slopes and sizes for anticipated flows. Maintenance of the underdrain system should be anticipated. Gravity outlet should be planned such that other developments and properties are not adversely affected.

9.0 PAVEMENT CONSIDERATIONS

Materials exposed at pavement subgrade elevations will be dependent upon native materials exposed at final overlot grading and the specific materials placed as fill at and near finish grade elevations. The predominate materials are generally expected to be silty sand, sandstone,

clayey sand, and claystone. Although clay was not encountered in the test borings, clay is known to exist in the area. Materials anticipated at subgrade elevation generally would be rated as good, with AASHTO classifications of A-1-b and A-2-6 which were determined for the sandstone and upper granular soils. Based on the shallow depths to claystone and final grading plans, claystone and clay may be encountered with typical AASHTO classifications of A-4 and A-6 which provide poor pavement support. The claystone will likely require overexcavation if within 18-inches of pavement sections. Thickness of asphalt pavements to be anticipated generally range between 4 to 5 inches of asphalt overlying 6 to 10 inches of basecourse depending on specific subgrade materials and Roadway Classification of each particular street. Cement treated subgrade thickness of 10 to 12 inches are common. Actual thickness may exceed anticipated thickness at some areas. For specific thickness determinations, a subsurface investigation and pavement design should be completed after completion of overlot grading.

10.0 ANTICIPATED RESIDENTIAL FOUNDATION SYSTEMS

Subsurface soil conditions consisted of granular materials with some areas of expansive clayey soils and claystone materials. We anticipate conventional spread footing foundation systems will be appropriate for residences constructed on the majority of the site. Where expansive materials are encountered at or near foundation grades, use of spread footings with overexcavation and replacement with non-expansive fill should be expected. Drilled pier foundations may be a suitable alternative where expansive soils are encountered. A Subsurface Soils Investigation report should be prepared after completion of overlot grading to address appropriate foundation systems. Perimeter below grade drain systems should be anticipated for all structures with basements. Overexcavation drains may also be recommended. Figures 3 and 4 present typical details. Shallow groundwater was encountered in numerous test borings. Temporary and permanent dewatering systems may be necessary at various foundation excavations. Shotrock and geotextiles may be appropriate for stabilizing excavations. An area wide subdrain may be considered for discharge of collected water.

11.0 RESIDENCE ON-GRADE FLOOR SLABS

On-grade floor slabs for the planned structures could be supported by on-site non-expansive soils or compacted, non-expansive, structural fill. Loose or expansive soils encountered at or

near floor slab grade should be penetrated or overexcavated a distance below slab subgrade and replaced with a non-expansive structural fill to improve floor slab performance. If slab movement and cracks cannot be tolerated a structural floor system should be used. Evaluation of subgrade materials should be included within a Subsurface Soils Investigation for each specific lot.

12.0 CONCRETE DEGRADATION DUE TO SULFATE ATTACK

Sulfate solubility testing was conducted on eight samples recovered from the test borings to evaluate the potential for sulfate attack on concrete placed below surface grade. The test results indicated less than 0.01 percent soluble sulfate (by weight). The test results indicate the sulfate component of the in-place soils presents a negligible exposure threat to concrete placed below the site grade. Type II cement is recommended for the on-site soils. Additional testing should be conducted following completion of overlot grading.

13.0 EXCAVATION STABILITY

Excavation walls must be properly sloped/benched or otherwise supported in order to maintain stable conditions. All excavation openings and work execution shall conform to OSHA standards as in CFR 29, Part 1926.650-652 (Subport D).

14.0 SURFACE AND SUBSURFACE DRAINAGE

Surface drainage will influence performance of structures at the site including streets and residences. Drainage is recommended around each building perimeter at a minimum slope of 5 percent in the first 10 feet adjacent to exterior foundation walls and for unpaved areas, where possible. For paved areas and other impervious surfaces, a minimum slope of 2 percent is recommended. Drainage should be planned to avoid ponding of water. Collected water and irrigation should discharge well beyond foundation backfill zones. Surface runoff should be designed to avoid sheet flow and erosion. Slopes should be protected from erosion by materials such as mulch or appropriate plants or other methods. All fills and backfills should be properly compacted. Unprotected surfaces may be subject to undesirable, heavy erosion.

15.0 WINTER CONSTRUCTION

In the event construction occurs during winter, concrete and soil materials should be protected from freezing conditions. Concrete should not be placed on frozen soil and once concrete has been placed, it should not be allowed to freeze. Similarly, once exposed, the soil subgrades should not be allowed to freeze. During grading operations and subgrade preparation, care should be taken to avoid burial of snow, ice or frozen material within the planned construction area.

16.0 CONSTRUCTION OBSERVATIONS

It is recommended that Entech observe and document the following activities during construction of the building foundations.

- Excavated subgrades and subgrade preparation.
- Placement of foundation perimeter drains (if installed).
- Placement/compaction of fill materials.
- Placement/compaction of utility bedding and trench backfill.

17.0 CLOSURE

The subsurface investigation, geotechnical evaluation and preliminary recommendations presented in this report are intended for use by Tech Contractors with application to the planned development of the single-family residential project site located in The Estates at Rolling Hills Ranch, Filing 1 and 2 subdivision in Meridian Ranch in northern El Paso County, Colorado. In conducting the preliminary subsurface soil investigation, laboratory testing, engineering evaluation and reporting, Entech Engineering, Inc. endeavored to work in accordance with generally accepted professional geotechnical and geologic practices and principles consistent with the level of care and skill ordinarily exercised by members of the geotechnical profession currently practicing in same locality and under similar conditions. No other warranty, expressed or implied is made. Additional subsurface investigations and testing are recommended to further evaluate the individual sites and roadways after final development plans are prepared and after the site has been graded. During final design and/or construction, if conditions are encountered which appear different from those described in this report, Entech Engineering, Inc. requests that it be notified so that the evaluation and recommendations presented herein can be reviewed and modified as appropriate.

If there are any questions regarding the information provided herein or if Entech Engineering, Inc. can be of further assistance, please do not hesitate to contact us.

TABLES

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT TECH CONTRACTORS
PROJECT ESTATES AT ROLLING HILLS
JOB NO. 191234

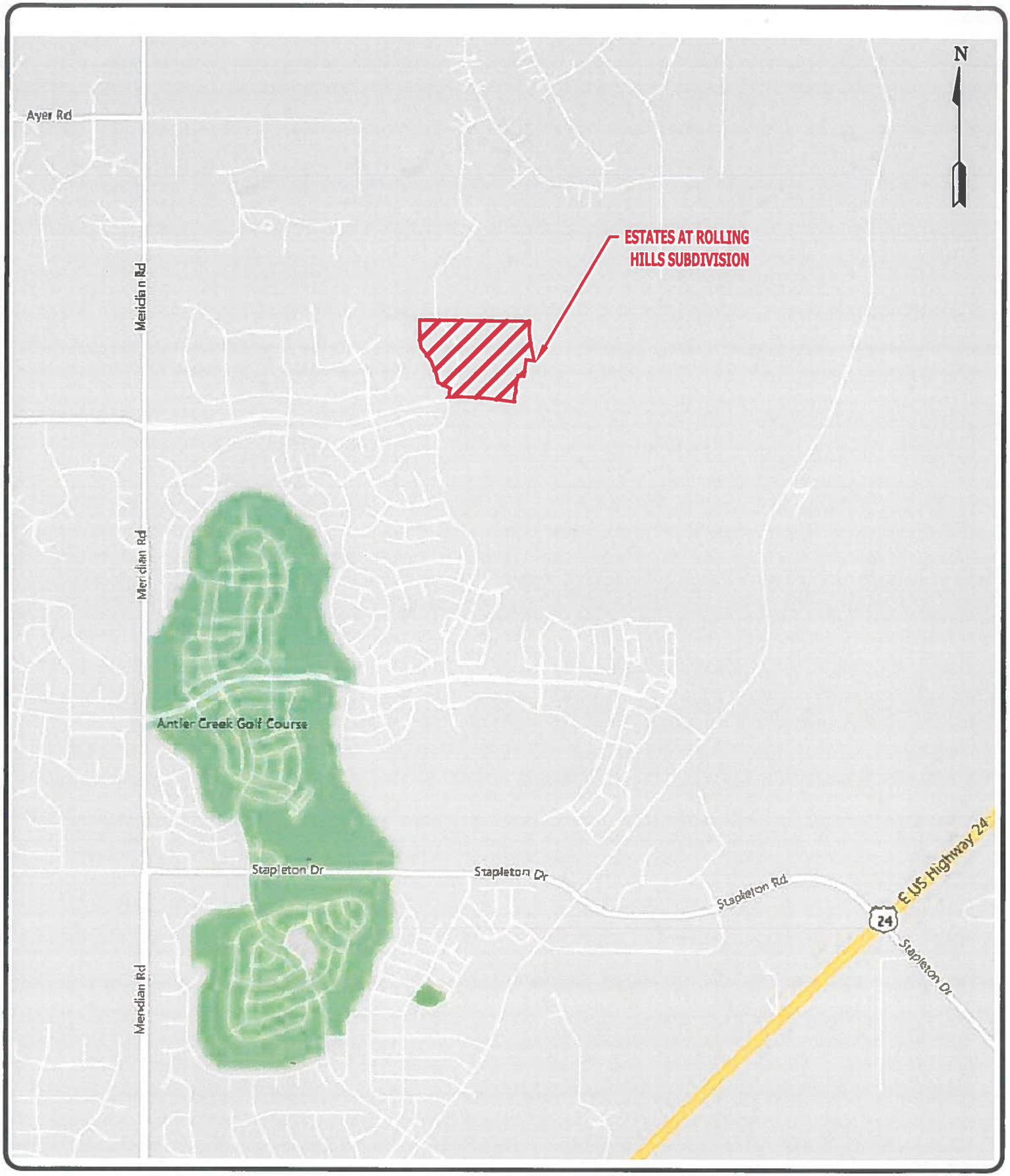
SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	AASHTO CLASS.	FHA SWELL (PSF)	SWELL/ CONSOL (%)	UNIFIED CLASS.	SOIL DESCRIPTION
1	1	5			22.3	33	16	<0.01	A-2-6			SC	SAND, CLAYEY
1	2	2-3			18.8			<0.01		30		SM	SAND, SILTY
1	6	5			17.0					130		SM	SAND, SILTY
1	10	2-3			8.0	NV	NP		A-1-b			SM-SW	SAND, SLIGHTLY SILTY
2	3	5			34.5	29	12	<0.01	A-2-6			SC	SANDSTONE, CLAYEY
2	4	10			23.5							SM	SANSTONE, SILTY
2	5	2-3			17.6							SM	SANDSTONE, SILTY
2	7	10			9.8	NV	NP		A-1-b			SM-SW	SANDSTONE, SLIGHTLY SILTY
2	8	15			8.4							SM-SW	SANDSTONE, SLIGHTLY SILTY
2	10	15	13.7	119.0	48.4						0.5	SC	SANDSTONE, VERY CLAYEY
3	12	5	14.5	119.7	58.3						3.1	CL	CLAYSTONE, VERY SANDY

Table 2: Summary of Test Borings and Water Measurements*

Test Boring No.	Depth of Boring (ft.)	Depth to Bedrock (ft.)	Depth to Groundwater (ft.)	Estimated Ground Elevation	Estimated Groundwater Elevation
1	20.0	9.0	dry	7180.4	dry
2	20.0	4.0	dry	7162.0	dry
3	20.0	1.0	16.0	7138.8	7017.3
4	20.0	1.0	dry	7134.9	dry
5	20.0	1.0	13.0	7146.6	7030.8
6	20.0	9.0	17.0	7159.9	7044.7
7	20.0	1.0	dry	7153.1	dry
8	20.0	1.0	dry	7136.0	dry
9	20.0	1.0	dry	7120.0	dry
10	20.0	9.0	12.0	7109.7	7063.5
11	20.0	1.0	14.0	7124.7	7062.6
12	20.0	4.0	dry	7133.7	dry

* - Measurement taken subsequent to drilling

FIGURES



ENTECH ENGINEERING, INC.
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VICINITY MAP
ESTATES AT ROLLING HILLS RANCH
EL PASO COUNTY, CO
FOR: TECH CONTRACTORS

DRAWN BY:	DATE DRAWN:	DESIGNED BY:	CHECKED:
SC	08/22/19	SC	SC

JOB NO.: 191234
FIG. NO.: 1

TEST BORING LOCATION PLAN
ESTATES AT ROLLING HILLS RANCH
EL PASO COUNTY, CO
FOR: TECH CONTRACTORS

DRAWN BY:	SC
DESIGNED BY:	SC
CHECKED BY:	
DATE:	04/22/19
SCALE:	AS SHOWN
JOB NO.:	19124
FIGURE NO.:	2

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

REVISIONS	BY:

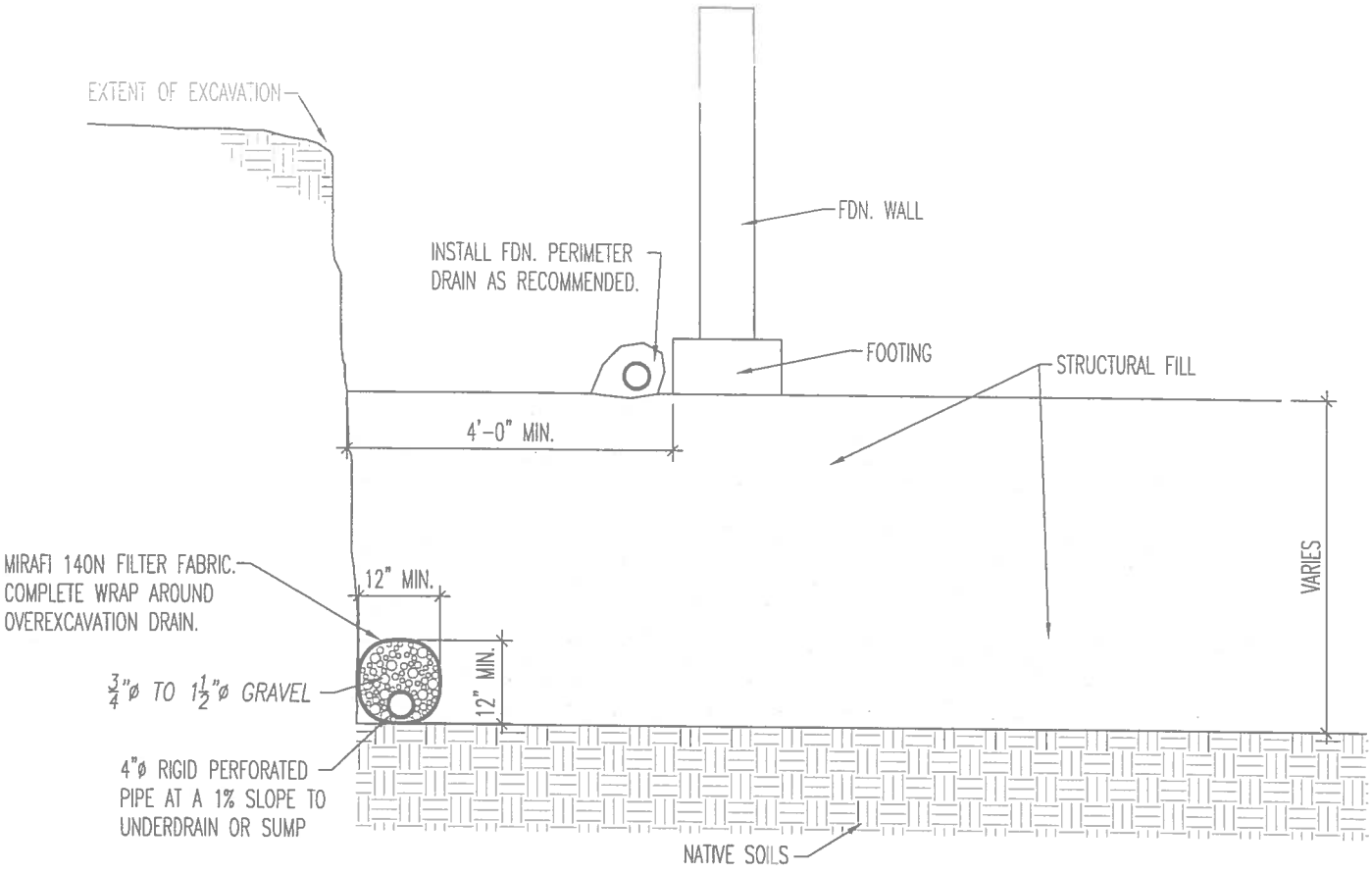
TB-2 (2) : APPROXIMATE TEST BORING LOCATION AND NUMBER (DEPTH TO BEDROCK)

N

REX ROAD

RH TH-18
RH TH-19
RH TH-21
RH TH-29
RH TH-20
NORTH TH-9
NO GW AT
25.0' (7077)
NORTH TH-11
NO GW AT
35.0' (7107)
NORTH TH-10
NO GW AT
40.0' (7104)
NORTH TH-12
NO GW AT
35.0' (7125)
NORTH TH-14
NO GW AT
40.0' (7146)

TH-1 — TB-1 (9)
TH-2 — TB-2 (4)
TH-3 — TB-3 (1)
TH-4 — TB-4 (1)
TH-5 — TB-5 (1)
TH-6 — TB-6 (9)
TH-7 — TB-7 (1)
TH-8 — TB-8 (1)
TH-9 — TB-9 (1)
TH-10 — TB-10 (9)
TH-11 — TB-11 (1)
TH-12 — TB-12 (4)



OVEREXCAVATION DRAIN DETAIL

N.T.S.

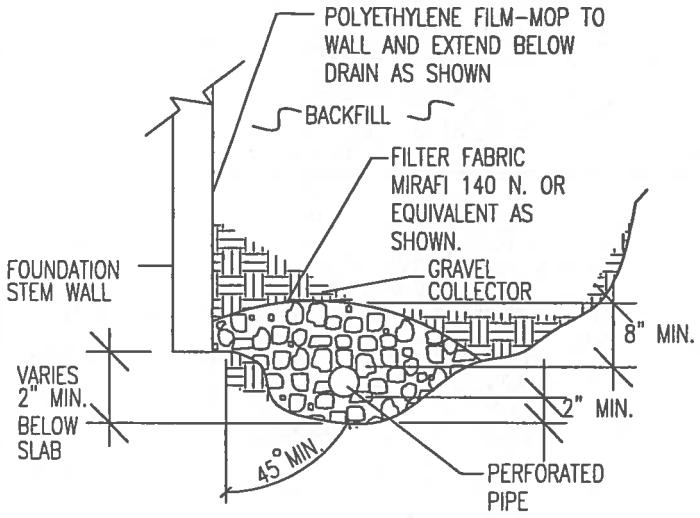
NOTE:

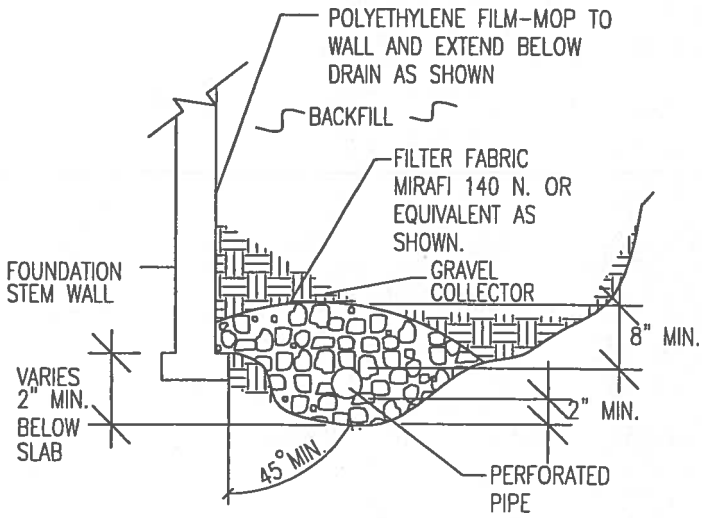
EXTEND DRAIN TO SUMP AS REQ'D.

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531-5599

OVEREXCAVATION DRAIN DETAIL			
DRAWN BY: M. WELLS	DATE DRAWN.	DESIGNED BY: D. STECMAN	CHECKED:

JOB NO.: 191234
FIG. NO.: 3





NOTES:

–GRAVEL SIZE IS RELATED TO DIAMETER OF PIPE PERFORATIONS–85% GRAVEL GREATER THAN 2x PERFORATION DIAMETER.

–PIPE DIAMETER DEPENDS UPON EXPECTED SEEPAGE. 4–INCH DIAMETER IS MOST OFTEN USED.

–ALL PIPE SHALL BE PERFORATED PLASTIC. THE DISCHARGE PORTION OF THE PIPE SHOULD BE NON–PERFORATED PIPE.

–FLEXIBLE PIPE MAY BE USED UP TO 8 FEET IN DEPTH, IF SUCH PIPE IS DESIGNED TO WITHSTAND THE PRESSURES. RIGID PLASTIC PIPE WOULD OTHERWISE BE REQUIRED.

–MINIMUM GRADE FOR DRAIN PIPE TO BE 1% OR 3 INCHES OF FALL IN 25 FEET.

–DRAIN TO BE PROVIDED WITH A FREE GRAVITY OUTFALL, IF POSSIBLE. A SUMP AND PUMP MAY BE USED IF GRAVITY OUT FALL IS NOT AVAILABLE.

ENTECH ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO. 80907 (719) 531–5599

PERIMETER DRAIN DETAIL

DRAWN:	DATE:	DESIGNED:	CHECKED:

JOB NO.: 191234

FIG NO.: 4

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 7/30/2019
Job # 191234

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 19', 8/7/19						
SAND, CLAYEY, FINE TO COARSE GRAINED, TAN TO BROWN, DENSE, MOIST				40	7.7	1
	5			32	11.9	1
SANDSTONE, CLAYEY, FINE TO COARSE GRAINED, BROWN, VERY DENSE, MOIST	10			50/6"	6.2	2
CLAYSTONE, VERY SANDY, BROWN, HARD, MOIST	15			50/10"	14.6	3
SANDSTONE, CLAYEY TO SILTY, FINE TO COARSE GRAINED, BROWN, VERY DENSE, MOIST	20			50/4"	7.7	2

TEST BORING NO. 2
DATE DRILLED 7/30/2019
CLIENT TECH CONTRACTORS
LOCATION ESTATES AT ROLLING HILLS

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 19', 8/7/19						
SAND. SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, MOIST				18	9.7	1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	5			50/10"	7.9	2
	10			50/8"	7.4	2
CLAYEY LENSES	15			50/8"	13.3	2
	20			50/6"	5.8	2

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE: 8/20/19

JOB NO.: 191234
FIG NO.: A- 1

TEST BORING NO. 3
DATE DRILLED 7/30/2019
Job # 191234

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER @ 16', 8/7/19						
SAND, SILTY, BROWN WEATHERED TO FORMATIONAL SANDSTONE, CLAYEY, FINE TO COARSE GRAINED, GRAY BROWN, DENSE TO VERY DENSE, MOIST				38	8.7	2
	5			50/7"	8.8	2
SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	10			50/7"	6.9	2
	15			50/7"	10.1	2
	20			50/5"	7.9	2

TEST BORING NO. 4
DATE DRILLED 7/30/2019
CLIENT TECH CONTRACTORS
LOCATION ESTATES AT ROLLING HILLS

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 20', 7/30/19 CAVED TO 17', 8/7/19, DRY						
SAND, SILTY, BROWN WEATHERED SANDSTONE, SILTY TO CLAYEY, FINE TO MEDIUM GRAINED, TAN, DENSE TO VERY DENSE, MOIST				50/10"	3.0	2
	5			45	11.3	2
SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	10			50/4"	5.5	2
	15			50/7"	6.8	2
CLAYEY LENSES	20			50/7"	7.0	2

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE: 8/12/19

JOB NO.: 191234
FIG NO.: A- 2

TEST BORING NO. 5
DATE DRILLED 7/30/2019
Job # 191234

REMARKS

WATER @ 13', 8/7/19

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					1
			50/7"	4.0	2
5			50/11"	10.1	2
10			50/7"	11.5	2
15			50/5"	8.2	2
20			50/7"	5.3	2

SAND, SILTY, BROWN

SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST

CLAYEY LENSES

TEST BORING NO. 6
DATE DRILLED 7/30/2019
CLIENT TECH CONTRACTORS
LOCATION ESTATES AT ROLLING HILLS

REMARKS

WATER @ 17', 8/7/19

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			34	4.7	1
5			42	7.7	1
10			50/7"	7.2	2
15			50/6"	12.4	2
20			50/8"	6.8	2

SAND, SILTY, FINE TO COARSE GRAINED, TAN, DENSE, MOIST

SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST

CLAYEY LENSES

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
			8/22/19

JOB NO.: 191234
FIG NO.: A- 3

TEST BORING NO. 7
DATE DRILLED 7/30/2019
Job # 191234

REMARKS

DRY TO 19', 8/7/19

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					1
			50/6"	6.4	2
5			50/6"	7.4	2
10			50/6"	6.8	2
15			50/7"	7.8	2
20			50/8"	8.6	2

SAND, SILTY, BROWN
SANDSTONE, SILTY, FINE GRAINED, TAN, VERY DENSE, MOIST
SANDSTONE, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST

TEST BORING NO. 8
DATE DRILLED 7/30/2019
CLIENT TECH CONTRACTORS
LOCATION ESTATES AT ROLLING HILLS

REMARKS

DRY TO 20', 7/30/19
CAVED TO 15', 8/7/19, DRY

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
					1
			50/10"	4.3	2
5			50/10"	8.5	2
10			50/8"	9.1	2
15			50/6"	9.1	2
20			50/10"	11.2	2

SAND, SILTY, BROWN
SANDSTONE, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST
SANDSTONE, VERY CLAYEY, FINE GRAINED, GRAY BROWN, VERY DENSE, MOIST

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
			8/22/19

JOB NO.: 191234
FIG NO.: A- 4

TEST BORING NO. 9
DATE DRILLED 7/30/2019
Job # 191234

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 19', 8/7/19						
SAND, SILTY, BROWN						1
SANDSTONE, SILTY TO CLAYEY, FINE TO COARSE GRAINED, TAN TO GRAY BROWN, VERY DENSE, MOIST				50/10"	5.0	2
	5			50/7"	7.9	2
VERY CLAYEY LENSES	10			50/8"	11.4	2
	15			50/6"	12.1	2
	20			50/6"	9.0	2

TEST BORING NO. 10
DATE DRILLED 7/30/2019
CLIENT TECH CONTRACTORS
LOCATION ESTATES AT ROLLING HILLS

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER @ 12', 8/7/19						
SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE, DRY TO MOIST				28	1.9	1
	5			29	7.2	1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	10			50/6"	6.9	2
SANDSTONE, VERY CLAYEY, FINE TO COARSE GRAINED, GRAY BROWN, VERY DENSE, MOIST	15			50/7"	9.8	2
	20			50/6"	9.9	2

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE: 8/22/19

JOB NO.: 191234
FIG NO.: A- 5

TEST BORING NO. 11
DATE DRILLED 7/30/2019
Job # 191234

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
WATER @ 14', 8/7/19						
SAND, SILTY, BROWN						1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, DRY TO MOIST				50/11"	1.6	2
	5			50/8"	6.8	2
	10			50/10"	7.9	2
CLAYSTONE, VERY SANDY, GRAY BROWN TO BROWN, HARD, MOIST	15			50/5"	9.5	3
	20			50/7"	8.2	3

TEST BORING NO. 12
DATE DRILLED 7/30/2019
CLIENT TECH CONTRACTORS
LOCATION ESTATES AT ROLLING HILLS

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 19', 8/7/19						
SAND, CLAYEY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST				15	12.3	1
CLAYSTONE, VERY SANDY, TAN, HARD, MOIST	5			50/11"	11.9	3
	10			50/5"	9.1	3
SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	15			50/7"	3.8	2
CLAYSTONE, VERY SANDY, TAN, HARD, MOIST	20			50/6"	12.7	3

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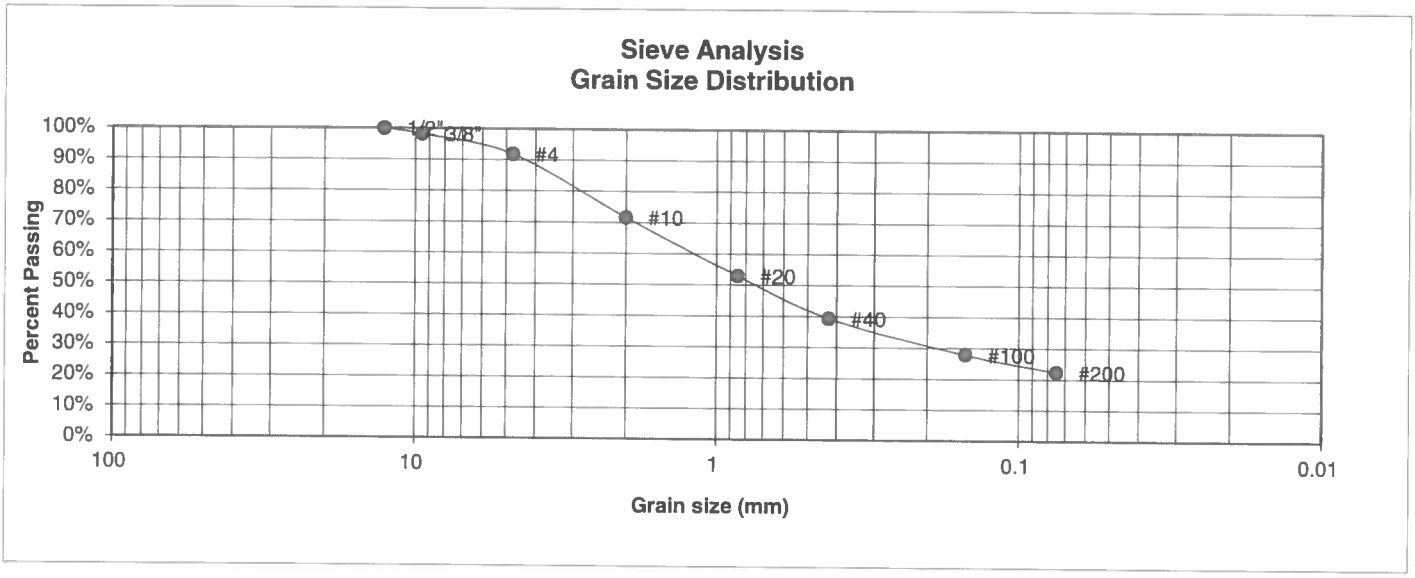
TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
			8/22/19

JOB NO.: 191234
FIG NO.: A- 6

APPENDIX B: Laboratory Test Results

UNIFIED CLASSIFICATION	SC	CLIENT	TECH CONTRACTORS
SOIL TYPE #	1	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	1	JOB NO.	191234
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.2%
4	91.8%
10	71.6%
20	52.9%
40	39.4%
100	27.8%
200	22.3%

Atterberg Limits

Plastic Limit	17
Liquid Limit	33
Plastic Index	16

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

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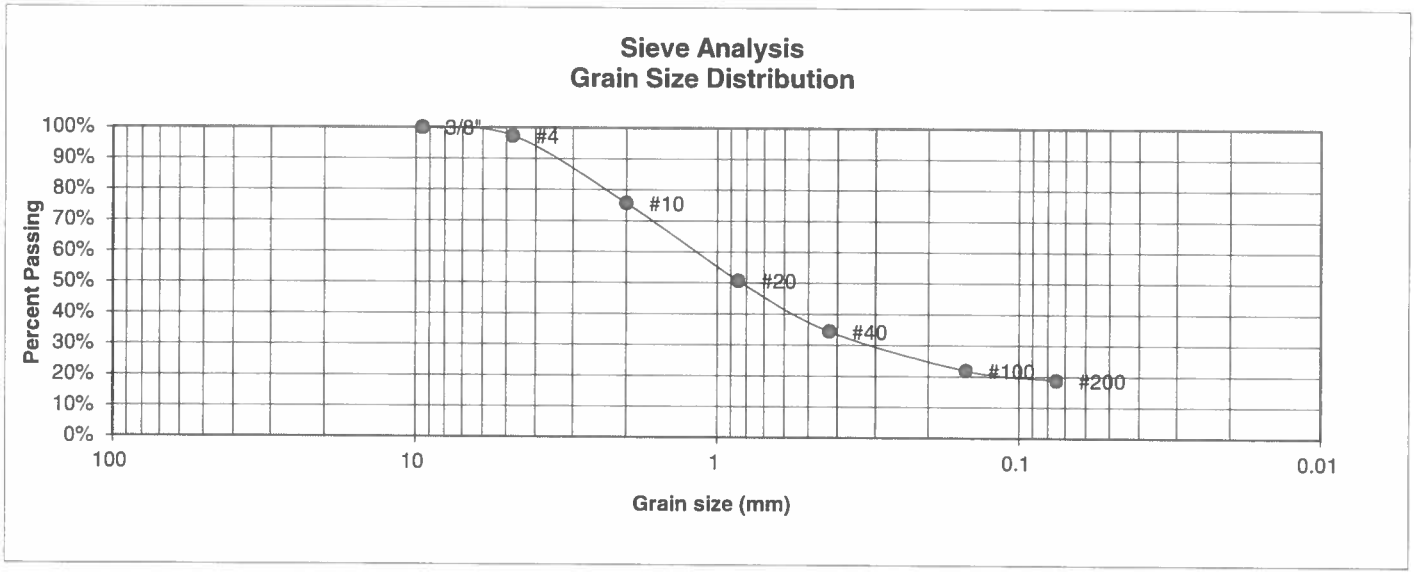
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			8/22/19

JOB NO.: 191234

FIG NO.: B-1

UNIFIED CLASSIFICATION	SM	CLIENT	TECH CONTRACTORS
SOIL TYPE #	1	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	2	JOB NO.	191234
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.4%
10	75.7%
20	50.7%
40	34.4%
100	21.9%
200	18.8%

Atterberg Limits

Plastic Limit	
Liquid Limit	
Plastic Index	

Swell

Moisture at start	11.8%
Moisture at finish	21.8%
Moisture increase	10.1%
Initial dry density (pcf)	95
Swell (psf)	30

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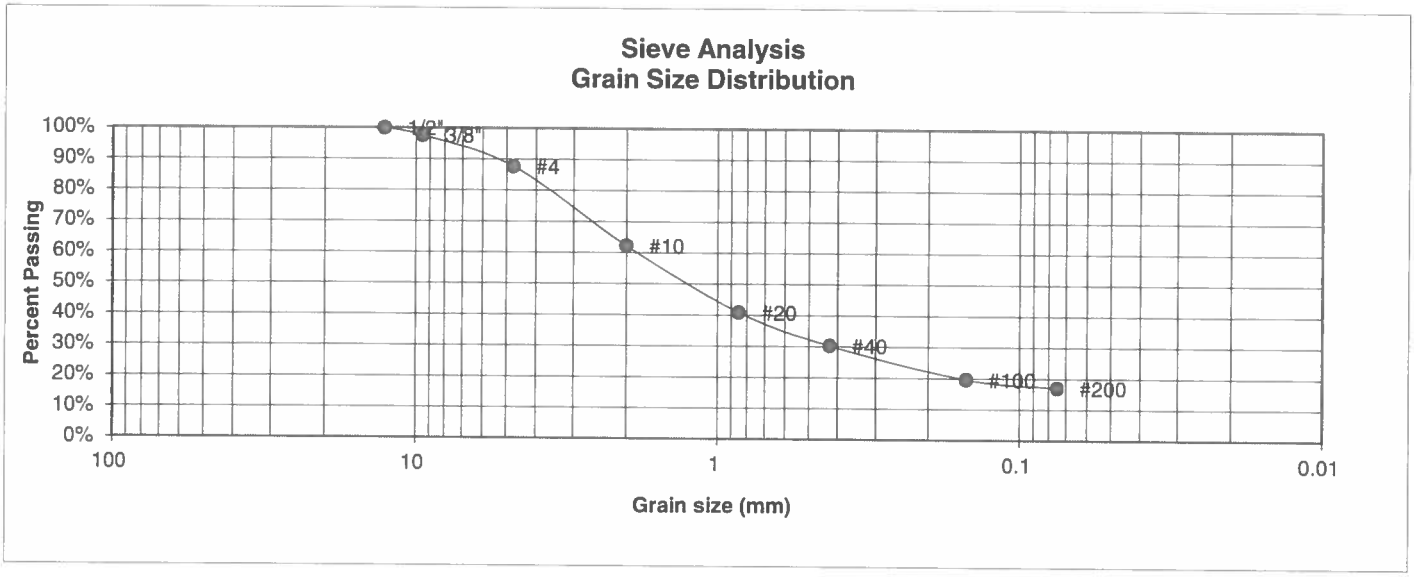
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 8/22/19

JOB NO.: 191234

FIG NO.: B-2

UNIFIED CLASSIFICATION	SM	CLIENT	TECH CONTRACTORS
SOIL TYPE #	1	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	6	JOB NO.	191234
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.6%
4	87.7%
10	62.2%
20	40.9%
40	30.3%
100	19.6%
200	17.0%

Atterberg Limits

Plastic Limit	
Liquid Limit	
Plastic Index	

Swell

Moisture at start	10.4%
Moisture at finish	20.1%
Moisture increase	9.6%
Initial dry density (pcf)	100
Swell (psf)	130

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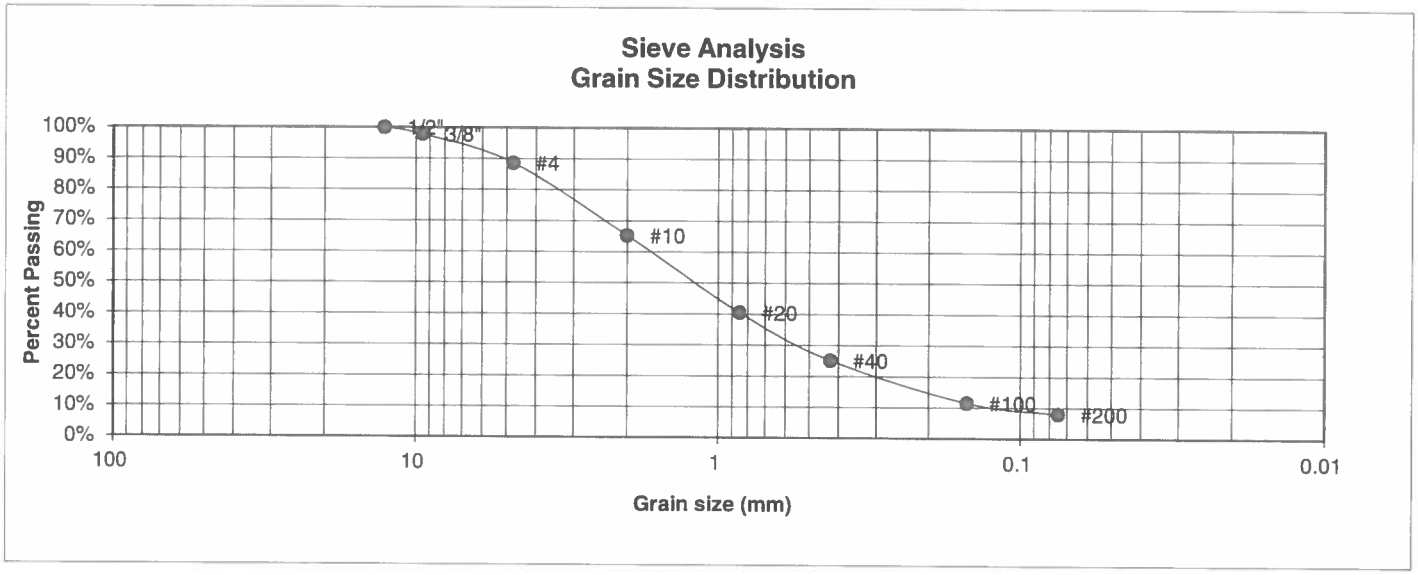
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 8/22/19

JOB NO.: 191234

FIG NO.: B-3

UNIFIED CLASSIFICATION	SM-SW	CLIENT	TECH CONTRACTORS
SOIL TYPE #	1	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	10	JOB NO.	191234
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.8%
4	88.6%
10	65.3%
20	40.5%
40	25.1%
100	11.5%
200	8.0%

Atterberg Limits

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

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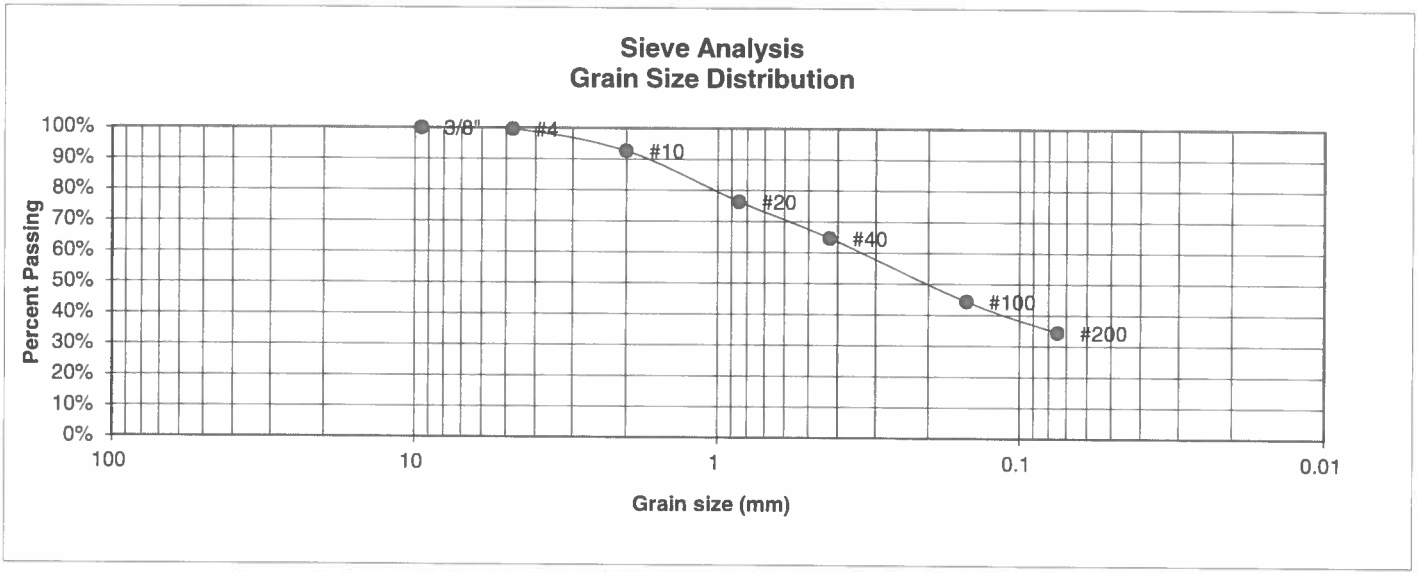
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 8/22/19

JOB NO.: 191234

FIG NO.: B-4

UNIFIED CLASSIFICATION	SC	CLIENT	TECH CONTRACTORS
SOIL TYPE #	2	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	3	JOB NO.	191234
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.6%
10	92.6%
20	76.4%
40	64.7%
100	44.4%
200	34.5%

Atterberg Limits	
Plastic Limit	17
Liquid Limit	29
Plastic Index	12

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	

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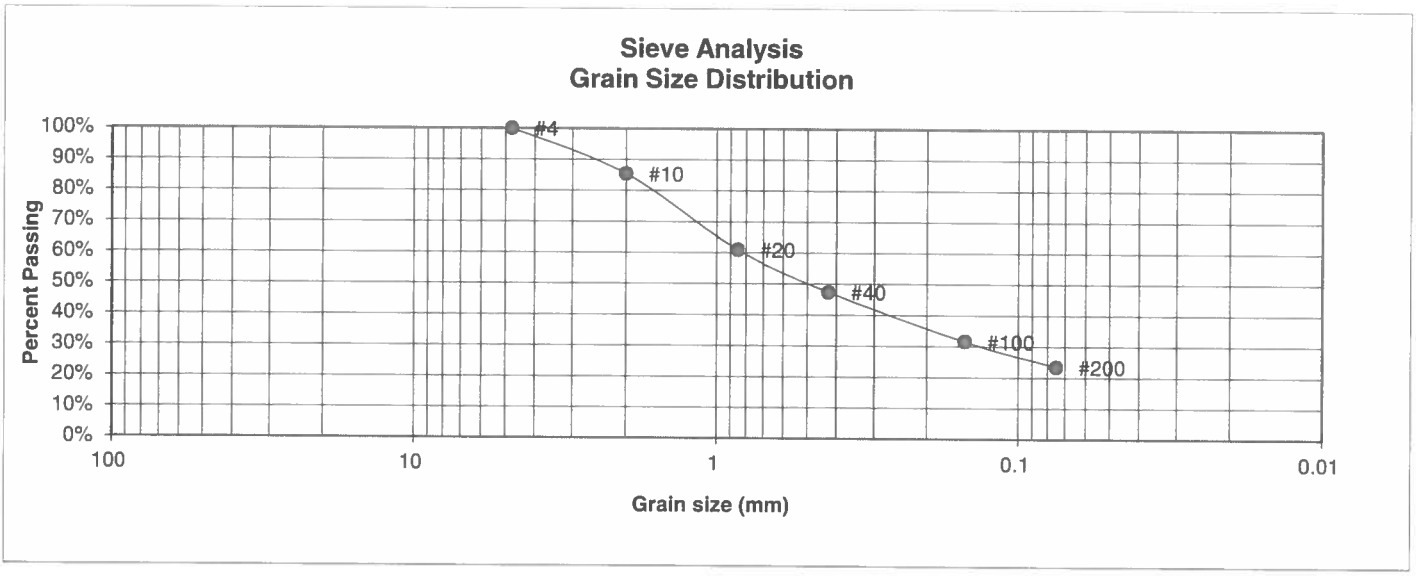
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 8/22/19

JOB NO.: 191234

FIG NO.: B-5

UNIFIED CLASSIFICATION	SM	CLIENT	TECH CONTRACTORS
SOIL TYPE #	2	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	4	JOB NO.	191234
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	85.4%
20	61.0%
40	47.4%
100	31.6%
200	23.5%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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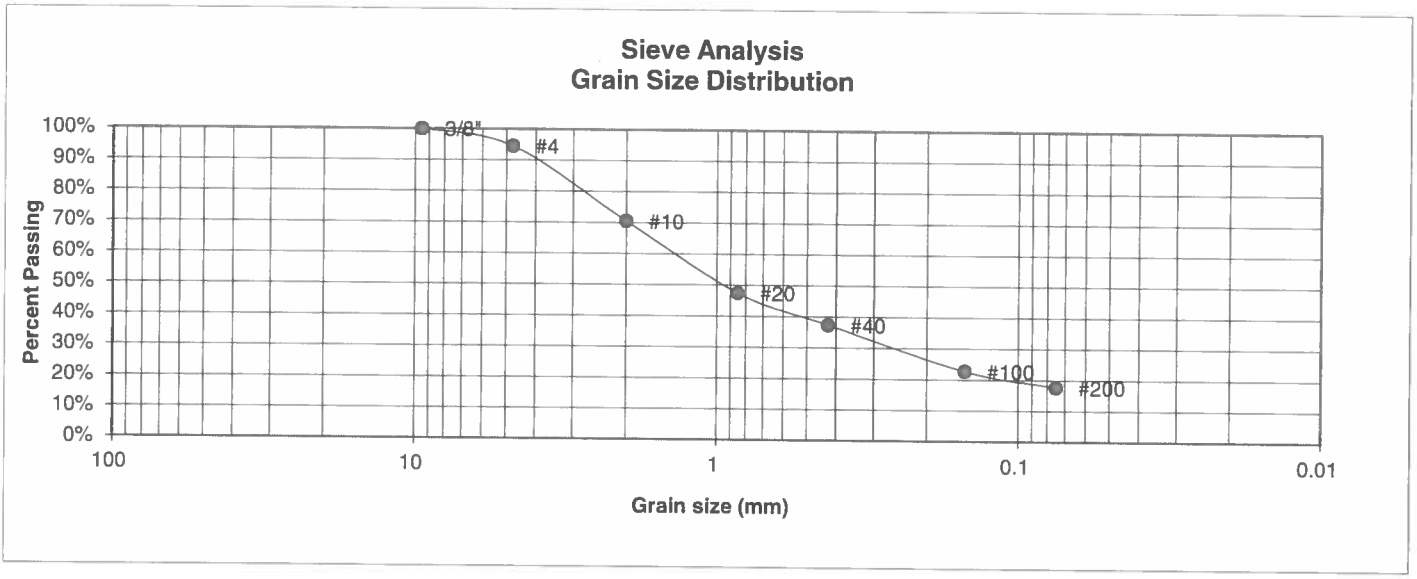
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 8/22/19

JOB NO.: 191234

FIG NO.: B-6

UNIFIED CLASSIFICATION	SM	CLIENT	TECH CONTRACTORS
SOIL TYPE #	2	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	5	JOB NO.	191234
DEPTH (FT)	2-3	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.5%
10	70.5%
20	47.5%
40	37.4%
100	22.7%
200	17.6%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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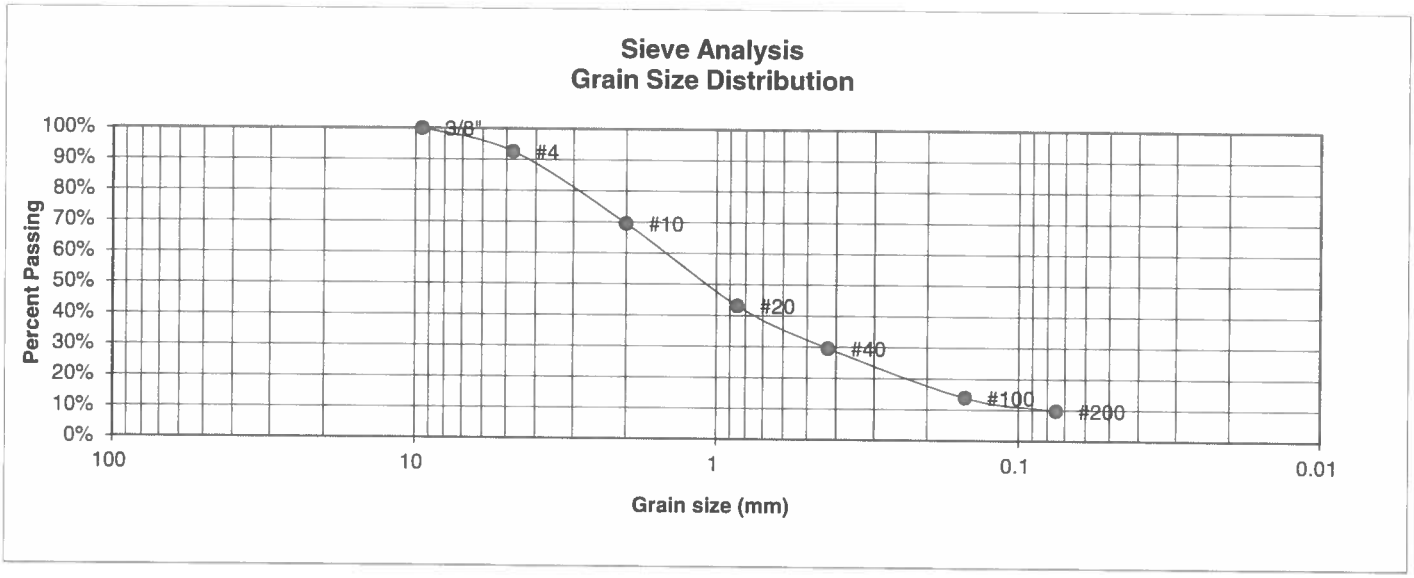
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 8/22/19

JOB NO.: 191234

FIG NO.: B-7

UNIFIED CLASSIFICATION	SM-SW	CLIENT	TECH CONTRACTORS
SOIL TYPE #	2	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	7	JOB NO.	191234
DEPTH (FT)	10	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	92.6%
10	69.5%
20	43.1%
40	29.6%
100	13.9%
200	9.8%

Atterberg Limits

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

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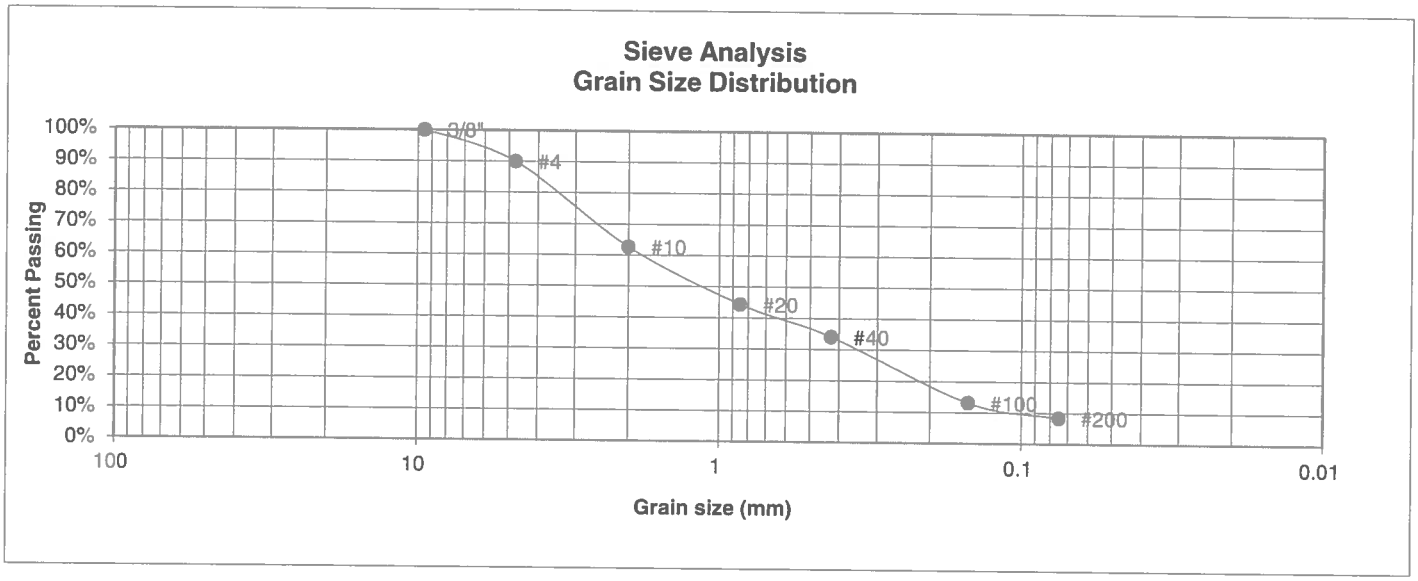
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			8/22/19

JOB NO.: 191234

FIG NO.: B-8

UNIFIED CLASSIFICATION	SM-SW	CLIENT	TECH CONTRACTORS
SOIL TYPE #	2	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	8	JOB NO.	191234
DEPTH (FT)	15	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	89.9%
10	62.7%
20	44.3%
40	34.1%
100	13.1%
200	8.4%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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LABORATORY TEST RESULTS

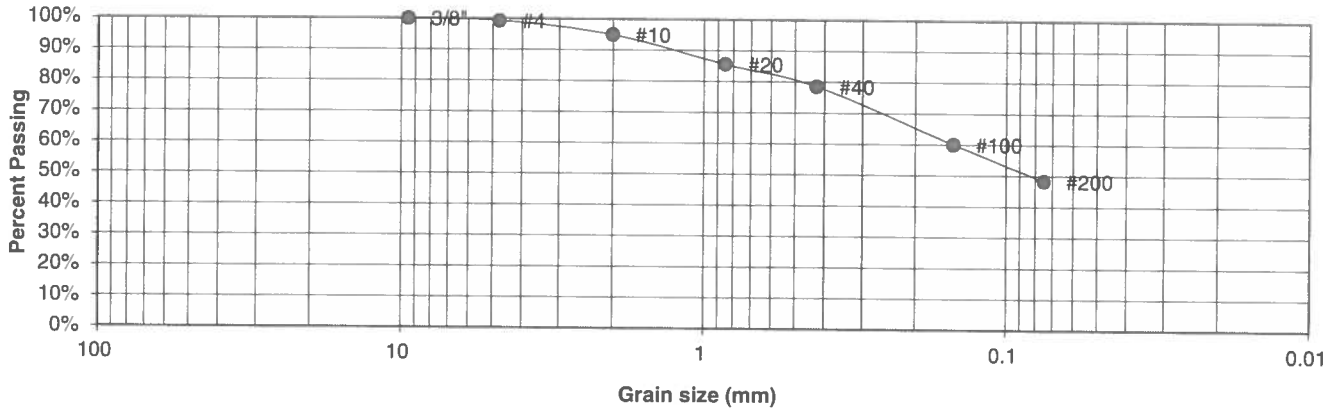
DRAWN:	DATE:	CHECKED:	DATE:
			8/22/19

JOB NO.: 191234

FIG NO.: B-9

UNIFIED CLASSIFICATION	SC	CLIENT	TECH CONTRACTORS
SOIL TYPE #	2	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	10	JOB NO.	191234
DEPTH (FT)	15	TEST BY	BL

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.3%
10	94.9%
20	85.6%
40	78.5%
100	60.1%
200	48.4%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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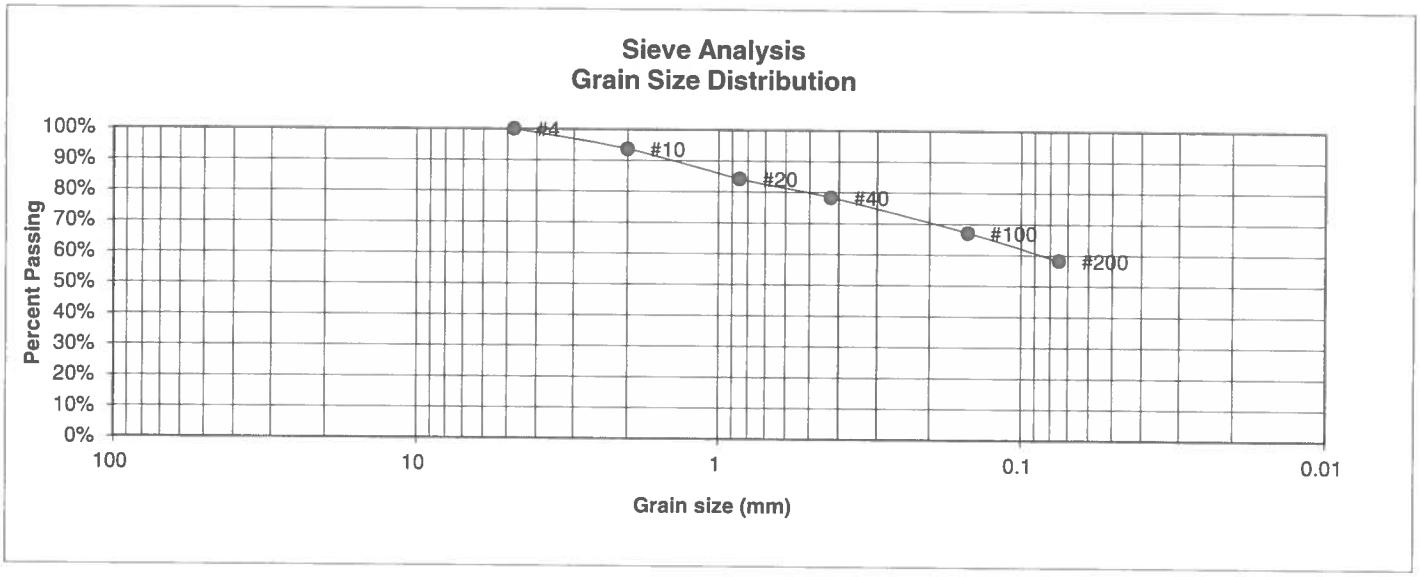
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 8/22/19

JOB NO.: 191234

FIG NO.: B-10

UNIFIED CLASSIFICATION	CL	CLIENT	TECH CONTRACTORS
SOIL TYPE #	3	PROJECT	ESTATES AT ROLLING HILLS
TEST BORING #	12	JOB NO.	191234
DEPTH (FT)	5	TEST BY	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	93.7%
20	84.2%
40	78.4%
100	67.2%
200	58.3%

Atterberg Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)

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505 ELKTON DRIVE
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LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			8/22/19

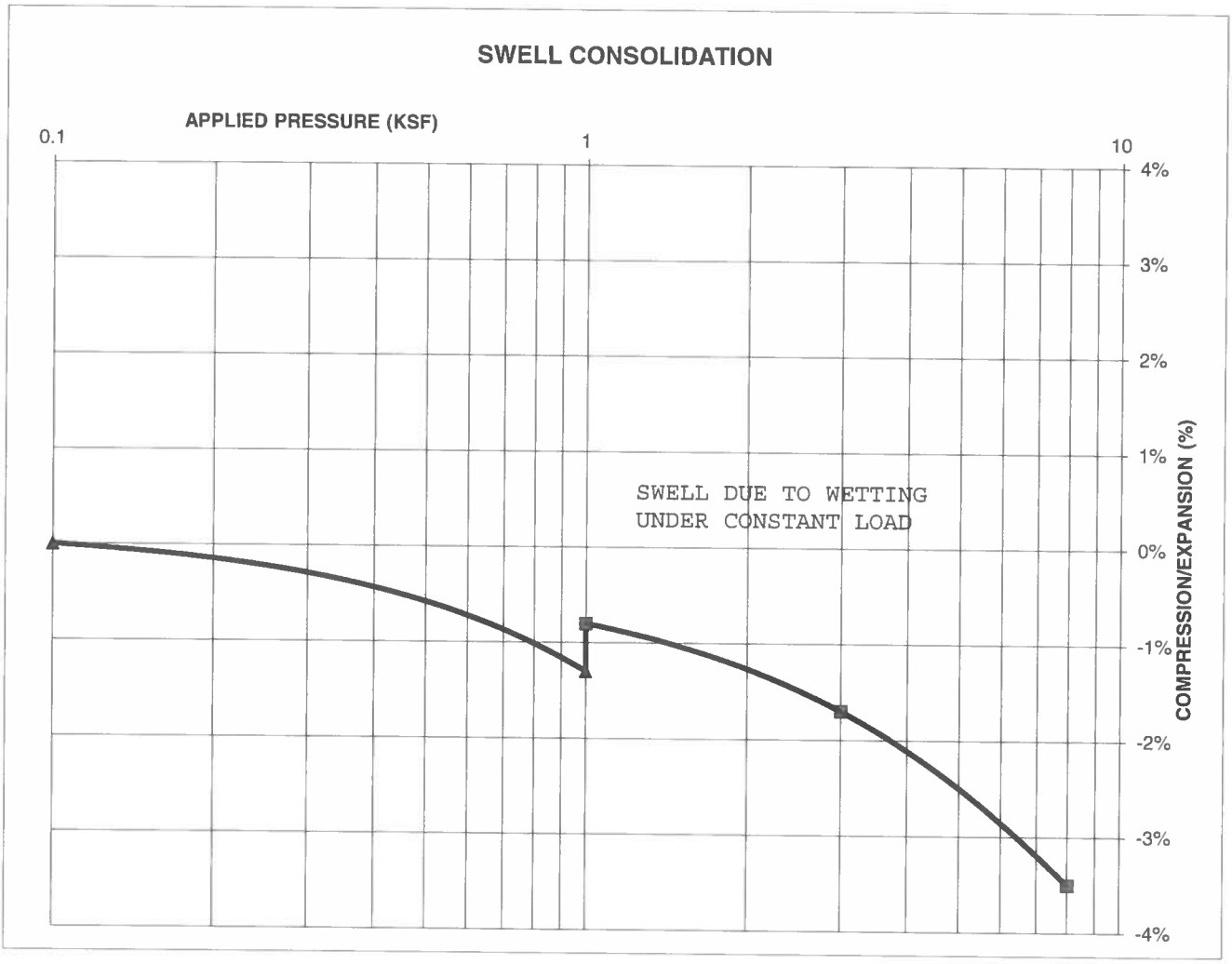
JOB NO.: 191234

FIG NO.: B-11

CONSOLIDATION TEST RESULTS

TEST BORING #	10	DEPTH(ft)	15
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			119
NATURAL MOISTURE CONTENT			13.7%
SWELL/CONSOLIDATION (%)			0.5%

JOB NO. 191234
CLIENT TECH CONTRACTORS
PROJECT ESTATES AT ROLLING HILLS



ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

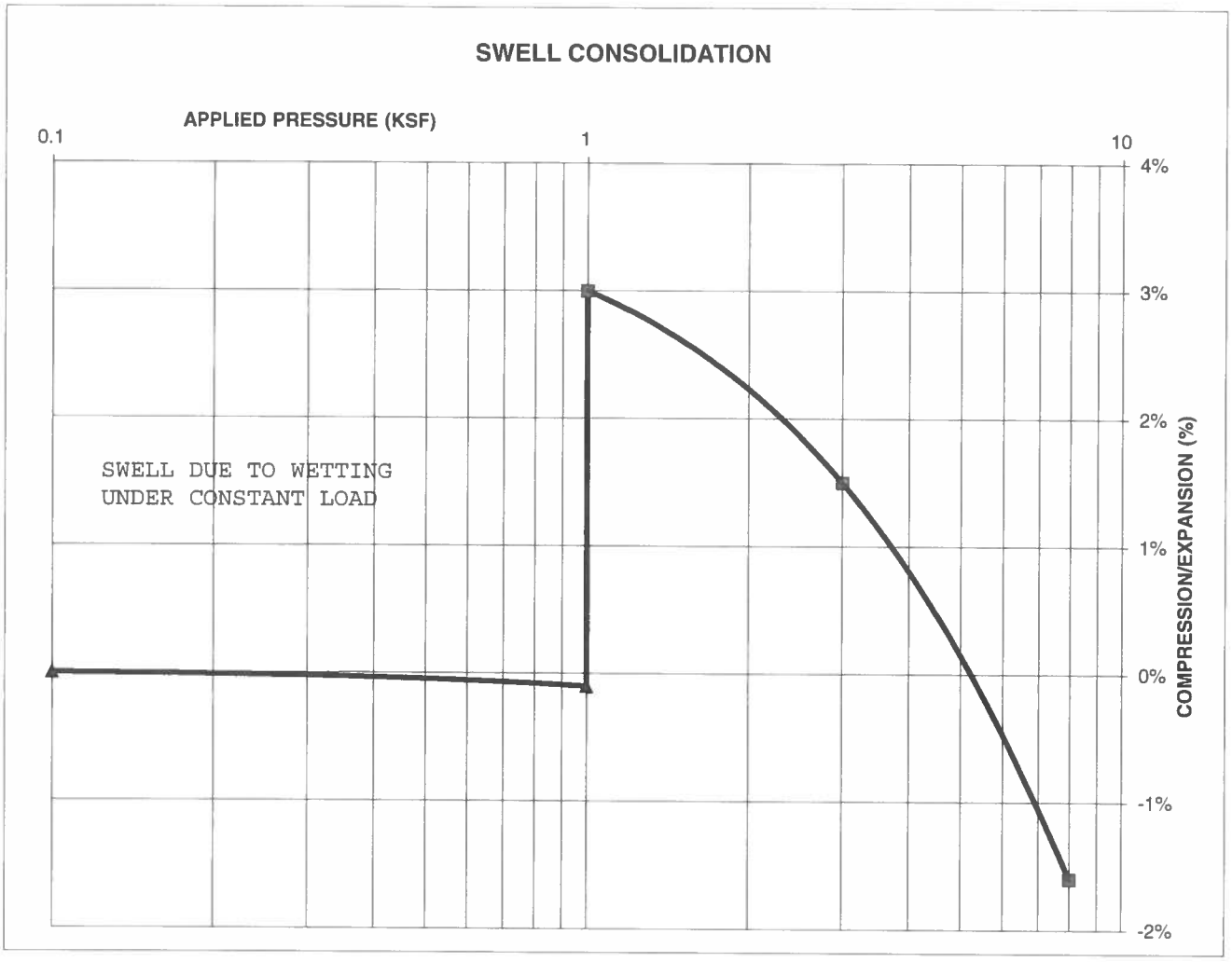
DRAWN:	DATE:	CHECKED:	DATE: 8/22/19

JOB NO.: 191234
FIG NO.: B-12

CONSOLIDATION TEST RESULTS

TEST BORING #	12	DEPTH(ft)	5
DESCRIPTION	CL	SOIL TYPE	3
NATURAL UNIT DRY WEIGHT (PCF)			120
NATURAL MOISTURE CONTENT			14.5%
SWELL/CONSOLIDATION (%)			3.1%

JOB NO. 191234
CLIENT TECH CONTRACTORS
PROJECT ESTATES AT ROLLING HILLS



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
			8/22/19

JOB NO.: 191234
FIG NO.: B-13

CLIENT	TECH CONTRACTORS	JOB NO.	191234
PROJECT	ESTATES AT ROLLING HILLS	DATE	8/19/2019
LOCATION	ESTATES AT ROLLING HILLS	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-1	5	1	SC	<0.01
TB-2	2-3	1	SM	<0.01
TB-3	5	1	SC	<0.01

QC BLANK PASS

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LABORATORY TEST
SULFATE RESULTS

DRAWN:	DATE:	CHECKED:	DATE: 8/28/19

JOB NO.: 191234

FIG NO.: B-14